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HANDLING AND ANALYSIS OF ICES IN CRYOSTATS AND GLOVE BOXES IN VIEW OF COMETARY SAMPLES

K. Roessler[1], G. Eich[1], M. Heyl[1], H. Kochan[2], A. Oehler[3], A. Patnaik[1], W. Schlosser[4], R. Schulz[1,2]; 1) Institut für Chemie 1 (Nuklearchemie) der Kernforschungsanlage, D-5170 Jülich 2) Institut für Raumsimulation der DFVLR, D-5000 Köln 90 3) Institut für Optoelektronik der DFVLR, D-8031 Oberpfaffenhofen 4) Astronomisches Institut der Ruhruniversität, D-4630 Bochum

Comet nucleus sample return mission and other return missions from planets and satellites need equipment for handling and analysis of icy samples at low temperatures under vacuum or protective gas. Two methods are reported here which were developed for analysis of small icy samples and which are modified at present for the larger samples in cometary matter simulation experiments (KOSI) [1,2]. They provide a base for the handling of return samples.

A conventional optical cryostat system was modified to allow for transport of samples at 5 K, ion beam irradiation, and measurement in an off-line optical spectrophotometer [3]. The new version consists of a removable window plug containing nozzles for condensation of water and volatiles onto a cold finger [4]. This plug can be removed in a vacuum system, changed against another plug (e.g. with other windows (IR, VIS, VUV) or other nozzles). While open, the samples can be treated under vacuum and cooling by manipulators (cut, revoval, sample taking, irradiation with light, photons, or ions). After bringing the plug back, the samples can be moved to another site of analysis.

For handling the 30 cm diameter mineral-ice samples from the KOSI experiments an 80x80x80 cm glove box made out of plexiglass was used. The samples were kept in a liquid nitrogen bath, which was filled from the outside. A stream a dry N_2 and the evaporating gas from the bath purified the glove box from impurity gases and, in particular, H_2O, which otherwise would condense onto the samples. The gas room around the sample had finally a temperature between -50°C and -70°C, which excluded any thermal effect of ev. warm gas on the surface of the sample. Likewise the tools, e.g. for sample taking, were stored in the glove box and cooled to a reasonable working temperature (-50°C). Handling of the sample was done with thick insolated gloves or manipulators. The size of the glove box and with it the temperature gradient were sufficient to impede conden-sation on the outer walls.

Besides optical inspection, sample taking, drilling of boreholes, measurement of mechanical properties (Newtonmeter from ESA-ESTEC, G. Schwehm), in particular, optical spectroscopy with a field spectrometer was performed under several angles in order to determine the albedo and the surface composition (A. Oehler). Other methods of spectroscopical analysis can easily performed inside or outside (optical beam). Another arrangement was used to the determine the composition of mixed ices (minerals-H_2O-CO_2-etc.). The ices were filled inside the glove box into small tight teflon containers with valves. Upon slow heating the volatile gases evolved were caught in cylinders. Gas samples were taken and analyzed by gaschromatography.

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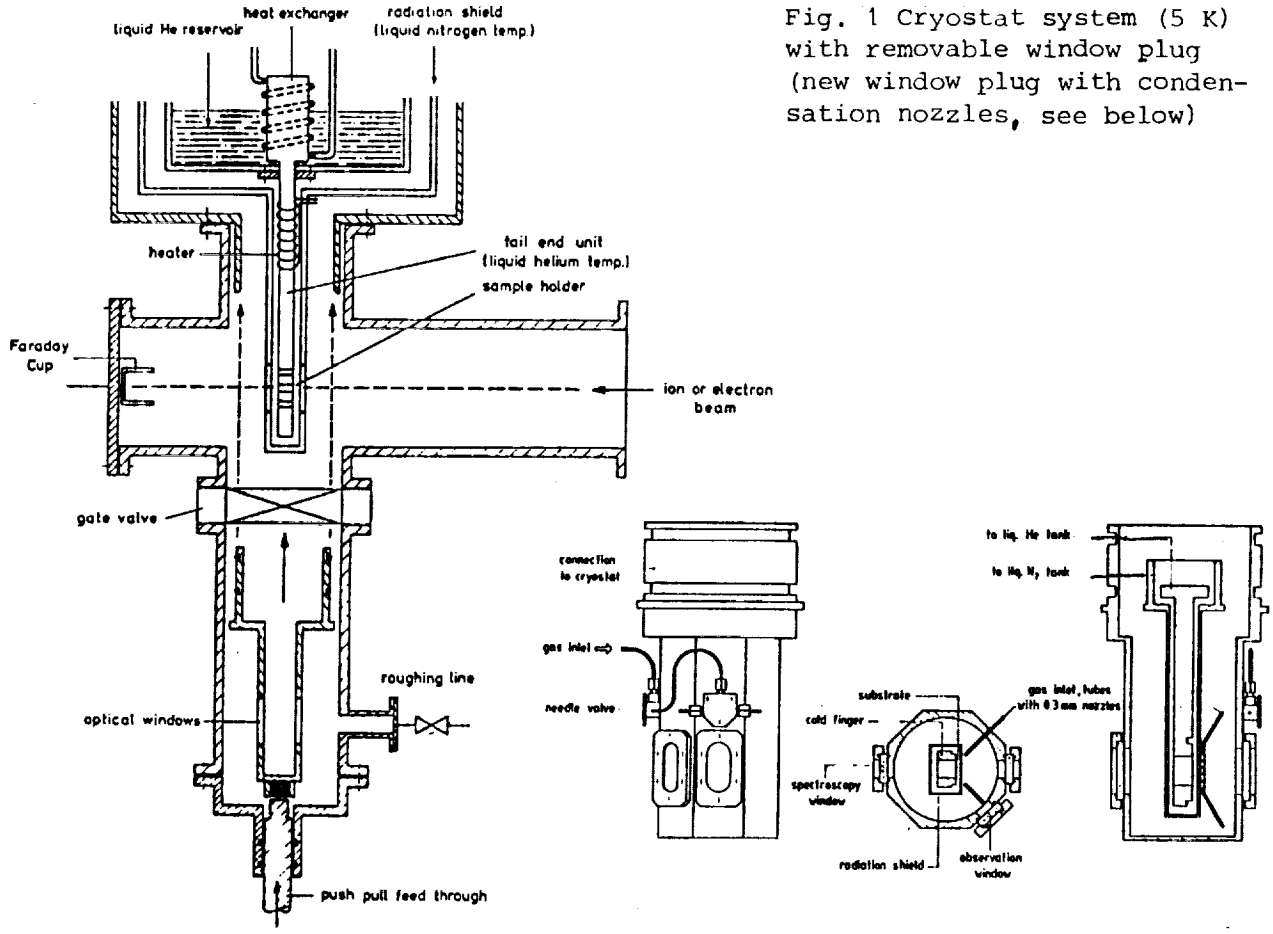
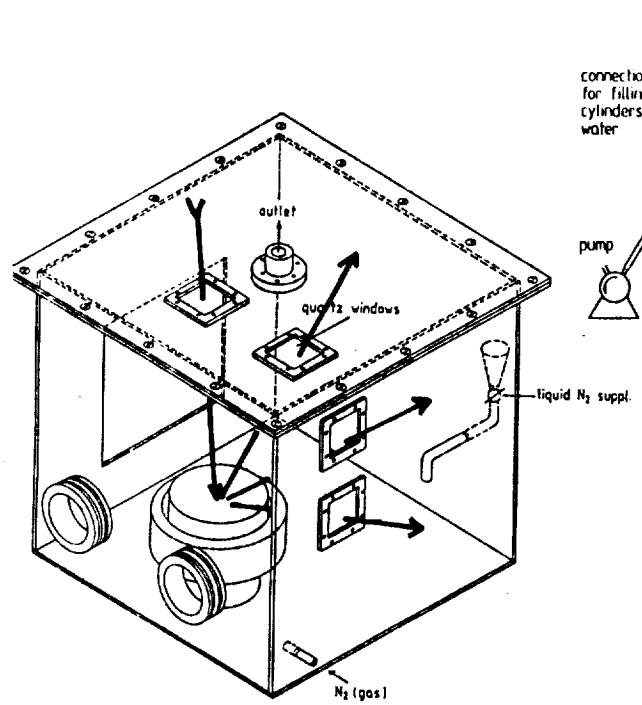


Fig. 1 Cryostat system (5 K) with removable window plug (new window plug with condensation nozzles, see below)



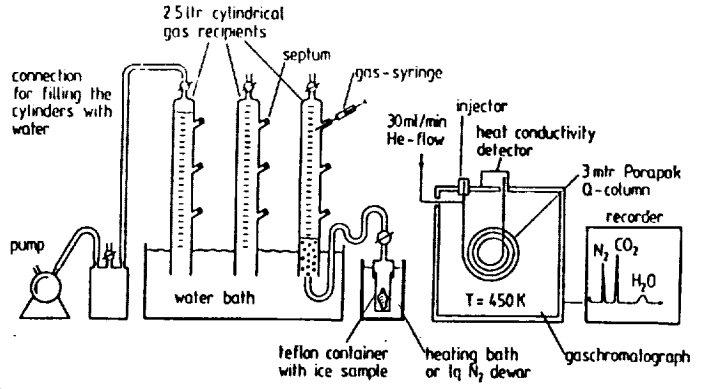


Fig. 2 Gaschromatography for compositional analysis of H_2O-CO_2-etc. ices

Fig. 3 Glove box with sample in liquid nitrogen dewar and optical pathways for reflexion spectroscopy (albedo)